

COST OF LAKE SURVEY.

LETTER
FROM
THE SECRETARY OF WAR,
TRANSMITTING

Report of the cost of different classes of work on Lake Survey.

FEBRUARY 8, 1879.—Referred to the Committee on Commerce and ordered to be printed.

WAR DEPARTMENT,
Washington City, February 7, 1879.

The Secretary of War has the honor to transmit to the House of Representatives a letter from the Chief of Engineers, dated the 6th instant, and a report from Maj. C. B. Comstock, Corps of Engineers, respecting the cost of different classes of work on Lake Survey from June 30, 1871, to June 30, 1878.

GEO. W. McCRARY,
Secretary of War.

The SPEAKER of the House of Representatives.

OFFICE OF THE CHIEF OF ENGINEERS,
Washington, D. C., February 6, 1879.

SIR: I beg leave to submit herewith a report from Maj. C. B. Comstock, Corps of Engineers, in charge of the Survey of the Lakes, respecting the cost of the different classes of work of that survey, as deduced by him from the results of the years between June 30, 1871, and June 30, 1878.

As the information that the report contains may prove to be of public interest at the present time in connection with government surveys, I would suggest that it be transmitted to the Senate and House of Representatives.

Very respectfully, your obedient servant,

A. A. HUMPHREYS,
Brigadier-General and Chief of Engineers.

Hon. GEORGE W. McCRARY,
Secretary of War.

WASHINGTON, D. C., *February 5, 1879.*

GENERAL: I have the honor to submit an approximate statement of the cost of different classes of Lake Survey work for the seven years ending June 30, 1878, as affording some aid in estimating the cost of extended surveys. I have not here the data for giving in detail the costs of the less important classes of work, such as magnetic work, water-level observations, aid to State surveys, aid in determining longitudes in the Territories, &c. For this reason, and also to avoid too great detail, the cost of all such miscellaneous work is divided among the other and principal classes, which are triangulation, topography, in-shore hydrography, and off-shore hydrography.

The topographical work of the Lake Survey for these years is of the best class not intended for cadastral purposes. Contour lines ten or twenty feet apart have been determined throughout the larger part of it. In-shore hydrography is that done with small boats by the shore-line parties, and extends usually to half or three-fourths of a mile from shore. Off-shore hydrography is that done with steamers outside of the in-shore hydrography.

The estimate is made by first classifying all expenses of the Lake Survey for seven years prior to June 30, 1878, under the four heads, triangulation, shore-party work, off-shore hydrography, and general office and miscellaneous.

For the period mentioned, the triangulation cost \$274,605.81; the shore-party work cost \$208,767.68; the off-shore hydrography cost \$237,775.91; while the general office and miscellaneous expenses cost \$282,342.37—making in all \$1,003,491.77. The total appropriations were \$1,060,000; the difference between this and the preceding sum is due to amounts expended on the Mississippi River Survey, and to amounts which reverted to the Treasury at the end of fiscal years.

The office and miscellaneous expenses are divided equally among the other three great classes of work, and then two-thirds of the resulting cost of shore-party work is taken as the cost of land work or topography and one-third as that of in-shore hydrography, this being about the ratio which experience has shown to exist between the costs of the two kinds of work done by a shore-party. Dividing the total cost of each class of work by the number of square miles done of each class, the average cost per square mile for the seven years results as shown in the following table:

	Triangulation.	Topography.	In-shore hydrography.	Off-shore hydrography.
Total cost of Lake Survey work for seven years ending June 30, 1878	\$368,719 93	\$201,921 20	\$100,960 60	\$331,890 03
Square miles of work	16,865.00	1,334.9	1,479	7,922.9
Cost per square mile	\$22	\$154	\$68	\$42

For a square mile covered by both triangulation and topography the cost would be \$154 + \$22, or \$173.

The cost of steamers has been charged here exclusively to off-shore hydrography, as that was their chief use. But they frequently aided the triangulation and topographical parties by moving or supplying them, and sometimes by building stations. If a part of their cost equal to the service rendered had been charged to triangulation and topography, it

would have diminished somewhat the cost of off-shore hydrography per square mile, by increasing the costs per square mile of the other classes of work. The increase for triangulation would not exceed about 50 cents per square mile; for topography, about \$10 per square mile, and for in-shore hydrography, about \$5 per square mile. During the period specified, there have been on an average five officers of engineers employed on the Lake Survey, whose pay of about \$11,900 per annum was derived from the appropriations for the Army. Should this be charged to the Lake Survey it would increase the costs already given of the work by about 7 per cent.

The cost of triangulation will vary very widely with the character of the country. Where, as on Lake Superior, a triangle with sides about a hundred miles in length can be obtained without the erection of lofty stations, the cost of such a triangle may be less than that of one whose sides are only fourteen miles long, but which, being in a perfectly flat and heavily-wooded country, requires very lofty stations to see over the tops of the trees. With triangles having sides fourteen miles long, the triangulation would require about fifty triangles to cover the area of a single triangle with sides of one hundred miles; and the cost in a flat, heavily-wooded country would be about fifty times as great. So, too, in topography the cost will vary very widely, as the country is much broken up into hills and ravines, requiring the determination of a large number of points to accurately represent the ground, or is a level prairie with few buildings, when a tenth part of the work might suffice. Hence, in trying to form an idea of the cost of a survey with a fixed amount of detail, averages which will include all kinds of country should be used.

It must be remembered, in using the above data to estimate the cost of an extended topographical survey, that the cost of office expenses and of instruments, per square mile of topography, would be considerably reduced when large areas were surveyed, and that several of the miscellaneous expenses now included in the above costs, such as water-level and meteorological observations, and longitude determinations of points not belonging to the survey, would almost disappear. Hence the cost found above, of \$173 per square mile, would be considerably reduced when large areas were covered.

Absent from the Lake Survey office at Detroit, I have not been able to supervise the collection of the data on which these estimates depend, but I have no reason to doubt their general accuracy.

In my letter to you of October 25, 1875, the total costs for 1872 and 1873 were divided among three of the classes named above instead of four; the cost of triangulation over a wide area being charged to a narrow area as explained in that letter. Hence, the costs per square mile so obtained, namely, topography \$326, in-shore hydrography \$160, and off-shore hydrography \$80, will be larger than, and not comparable with, those previously given in this letter; but those given in this letter for seven years include, among others, both of the years 1872 and 1873, and being for a longer period will give more nearly correct average values than an application of the method used in this letter to the years 1872 and 1873 alone.

Very respectfully, your obedient servant,

C. B. COMSTOCK,

Major of Engineers, Brevet Brigadier-General.

Brig. Gen. A. A. HUMPHREYS,

Chief of Engineers.

